Ownership matrix	**RPP-27195**

1.0 PURPOSE AND SCOPE

This standard provides information on the recognition and control of cold stress hazards, and applies to all Tank Operations Contractor (TOC) and all subcontractor activities.

Medical services are outside the scope of this document, and are provided by the designated Site Occupational Medical Contractor (SOMC).

2.0 IMPLEMENTATION

This standard is effective on the date shown in the header.

3.0 STANDARD

(5.1.1)

This standard is to protect workers from the effects of cold stress (hypothermia) and cold injury effects to the body core and extremities. This standard is to be used to assess the hazard presented by work in cold environmental conditions and to identify appropriate controls to mitigate the hazard.

3.1 General Guidelines

1. Pain in the extremities may be the first sign of cold stress, and may progress to shivering.

2. Workers should be dressed in layers to trap warm air next to the body.

3. The employees' supervisor/manager shall verify that each worker has been issued appropriate cold weather gear. The employee is responsible to ensure that their company-issued clothing is available for use when temperatures are below a dry bulb temperature of 40°F.

4. Workers should not touch any metal with bare hands below a dry bulb temperature of 19 degrees F.

5. Workers who become immersed in water or whose clothing becomes wet at temperatures of less than a dry bulb temperature of 35 degrees F must be immediately provided dry clothing and referred to medical as necessary.

6. Workers should take warming breaks, as needed (see Table 1). When exposures to cold weather causes severe shivering, employees should immediately leave the cold environment and go to a warming shelter.

7. For work performed at or below 10 degrees F equivalent chill temperature (ECT), the following work practices apply:

- Workers should be under constant protective observation (e.g., buddy system or supervision)
- New employees who have not recently worked in cold weather should not be required to work full time (≥8 hours) in the cold during the first few days of employment until they become accustomed to the working conditions and required protective clothing
- The weight and bulkiness of clothing should be accounted for when estimating the required work performance and weights lifted by the worker
- Minimize both heavy and sedentary work. If the work rate causes heavy sweating that could result in wet clothing, rest breaks should be taken in heated shelters and the opportunity to change into dry clothing should be provided.

8. Avoid continuous exposure to bare skin when the Equivalent Chill Temperature is below -26 degrees F.

9. "Normal Breaks" are considered warm-up breaks that start at <60 degrees F, are taken at least for 10 minutes every two hours and can include additional warm-up breaks if Table 1 applies (Table 1 begins to apply at a dry bulb temperature of < -15 degrees F).

10. If work will include work in a full set of impermeable ensemble(s) for more than 30 minutes, then Physiological Monitoring may be necessary.

3.2 Training

Before working in extreme cold (i.e., dry bulb temperatures below 10 degrees F), employees will be trained on cold stress hazards utilizing a briefing. This briefing will be presented annually as a Safety Start-up series of topics. At a minimum, this training must include:

- Proper rewarming procedures and appropriate first aid treatment
- Proper clothing practices
- Proper eating and drinking habits
- Recognition of impending frostbite
- Recognition of signs and symptoms of impending hypothermia (see Attachment A) or excessive cooling of the body even when shivering does not occur
- Safe work practices.

3.3 Cold Stress Evaluation

Safety and Health may evaluate weather conditions and recommend controls as necessary.

Workplace monitoring for Cold Stress is required as follows:

1. The IHT or Field Work Supervisor will call the Hanford Meteorological Station (509-373-2176) every four hours at 60 degrees F to 30 degrees F. The IHT can alternatively use the WBGT for dry bulb temperature readings. These temperatures are "visually checks" and do not need to be recorded.

2. When the dry bulb temperature at the work place falls below 30 degrees F, the dry bulb temperature, wind speed, and equivalent chill temperature (the equivalent chill temperature is determined from Table 2) may be recorded on form A-6006-434 every four hours. Also, the dry bulb temperature, wind speed, and equivalent chill temperature can be obtained from the Hanford Meteorological Station at (509-373-2716).

3. A cold stress mitigation checklist is not required (as one is for the heat stress program).

4. The completed cold stress form (A-6006-434) is a data collection tool that does not need to be retrained for record.

3.4 Cold Stress Controls

3.4.1 Engineering Controls

If work is performed continuously in the cold for more than 2 hours with an Equivalent Chill Temperature at or below 19 degrees F (Table 2) for more than 2 hours, work/warming regimens must be implemented (Table 1) and heated warming areas, vehicles, or shelters be made readily available nearby.

Whenever possible, engineering controls should be used to minimize the stress of a cold environment. Engineering controls may include:

- General or spot heating
- Wind shielding
- Insulated metal tool handles
- Warming areas.

3.4.2 Administrative Controls

When engineering controls are not feasible, administrative controls may be instituted to reduce the potential for cold disorders.

Administrative controls may include:

- Adjusting work/warm-up schedules (see Table 1)
- Providing warm drinks
- Scheduling work during the warmest part of the day
- Assigning extra workers
- Allowing workers to pace themselves
- Training on cold stress prevention

- Utilizing a buddy system for work at an Equivalent Chill Temperature of

  < 10 degrees F

- Allowing new employees to become accustomed to the working conditions and required protective clothing

- Arranging work to avoid standing in the cold for extended periods

- Minimizing both heavy and sedentary work.

3.4.3 Personal Protective Controls

When engineering and administrative controls to prevent cold stress are not adequate, personal protective controls should be implemented. Personal protective controls may include:

- Use of protective clothing for the hands, feet, and head (the most important area)
- Layers of clothing to create dead air space
- Use of loose fitting cotton clothing
- Changes of socks when wet
- Use of a liner when a hard hat is used
- Use of a head covering to prevent heat loss from the head
- Use of hand warmers to provide an additional heat source
- Avoid using tight fitting gloves that could restrict circulation to the hands and fingers
- Use of gloves (when manual dexterity is not required) when:
  - Dry bulb temperature is < 60 degrees F for sedentary work
  - Dry bulb temperature is < 39 degrees F for light work
  - Dry bulb temperature is < 19 degrees F for moderate work
  - Dry bulb temperature is < 0 degrees F; mittens should be used.

3.5 Medical Surveillance

Employees who are routinely exposed to dry bulb temperatures below 0 degrees F must have this indicated on their EJTA and be medically certified as suitable for such exposures. These environmental conditions are rare at tank farms and it is anticipated that employees would not be routinely exposed to these extreme cold temperatures.

Workers with work restrictions specific to cold exposure must notify their supervisor and should be excluded from work below a dry bulb temperature of 30 degrees F unless medically approved.

4.0 DEFINITIONS

Acrocyanosis. A benign condition where the hands and feet may take on a blue, purple, or grayish hue upon exposure to cold.

Equivalent chill temperature (ECT). Otherwise known as wind chill temperature, ECT is an estimate of the combined cooling effect of wind and low air temperatures on exposed skin.

Frostbite. Freezing or the local effect of a partial freezing of some part of the body.

- First degree: freezing without blistering or peeling
- Second degree: freezing with blistering or peeling
- Third degree: freezing with death of skin tissues and deeper tissues.

Hypothermia. The body's inability to thermo-regulate upon cold exposure. Symptoms include uncontrollable shivering, a sensation of cold, slurred speech, memory lapses, incoherence, drowsiness, exhaustion, slow or irregular heartbeat, weak pulse, and blood pressure changes.

Raynaud's phenomenon. A condition characterized by reduced blood flow to the extremities (especially the fingers). Symptoms include numbness, itching, tingling, or a burning sensation upon cooling of the skin.

Trench foot. Swelling, tingling, itching, pain, blistering, or ulceration of the foot caused by continuous exposure of the foot to both cold and dampness.

5.0 SOURCES

5.1 Requirements

5.1.1 10 CFR 851, "Worker Safety and Health Program."

5.2 References

5.2.1 American Conference of Governmental Industrial Hygienists (ACGIH), "2016 Threshold Limit Values for Chemical Substances, Physical Agents and Biological Exposure Indices."

5.2.2 TFC-ESHQ-IH-STD-03, "Exposure Monitoring, Reporting, and Records Management."

5.2.3 TFC-ESHQ-RP_ADM-CD-21, "Radiological Controls for Heat and Cold Mitigation."

5.2.4 TFC-ESHQ-S_IH-C-17, "Employee Job Task Analysis."

5.2.5 TFC-OPS-MAINT-C-01, "Tank Operations Contractor Work Control."

5.2.6 TFC-OPS-MAINT-C-02, "Pre-Job Briefings and Post-Job Reviews."

Table 1. TLVs/Warm-Up Schedule for Outside Workers Based on a Four-Hour Shift.

The ACGIH provides the following guidelines for working outdoors in cold weather conditions. These guidelines recommend protective clothing and limits on exposure time. The recommended exposure times are based on the wind chill factor, a scale based on air temperature (dry bulb) and wind speed. The work break schedule applies to any four-hour period with moderate or heavy activity. Warm-up breaks are ten minutes long in a warm location. The schedule assumes that "normal breaks" are taken for at least 10 minutes for once every two hours. At the end of a four-hour period, an extended break (e.g., lunch break) in a warm location is recommended.

Air Temperature (dry bulb) - Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx)	°F (approx)	Max. work Period	No. of Breaks*	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29°to -31°	-20°to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25°to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
-40° to -42°	-40°to -44°	30 min.	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

*2005 TLVs and Biological Exposure Indices (BEIs) - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.

a. Schedule applies to any four-hour work period of moderate-to-heavy work with warm-up periods of ten minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For light-to-moderate work (limited physical movement), apply the schedule one step lower. For example, at a dry bulb temperature of -35 degrees C (-30 degrees F), with no noticeable wind, a worker at a job with little physical movement should have a maximum work period of 40 minutes with four breaks in a four-hour period.

b. TLVs apply only for workers in dry clothing.

Table 2. Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature.

Table 2 shall be used to determine the equivalent chill temperature (ECT). To use Table 2, obtain the Actual temperature reading, in degrees F, (ambient air Dry Bulb temperature) and wind speed from the US DOE Hanford Meteorological Station (509-373-2716). Find the temperature on the top of the table closest to the actual temperature. Read down the column until you are level with the estimated wind speed. The number which appears at the intersection of the temperature column and wind speed row is the equivalent wind chill temperature. If the Meteorological Station conditions are not representative of working conditions, site specific temperature and wind speed can be obtained through an Industrial Hygiene Technician.

Estimated wind speed (in mph)	Actual temperature reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent chill temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect)	LITTLE DANGER In less than an hour with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute			GREAT DANGER Flesh may freeze within 30 seconds				

At windchill <19.4°F heating shelter access is required for work outside lasting more than 2 hours.

ATTACHMENT A – SYMPTOMS OF COLD EXPOSURE AND COLD STRESS FACTORS

1. Symptoms of Cold Exposure

Exposure to low temperatures may be a factor if work is done in the evening hours, if winds are high, if unpredictable weather moves in, or during the winter months.

The body works best at and tries to maintain a set internal temperature of approximately 99-100°F. When the body temperature decreases much below this set point, the body's temperature regulation system acts to conserve heat and generate new heat. The first physiologic response is constriction of blood vessels, inhibiting sweat gland function and/or shivering, and releasing extra glucose for heat production.

Workers should observe each other's facial extremities (ears and nose) and exposed skin for signs of frostbite (whitening of the skin surface) or acrocyanosis (a blue, purple or grayish hue). Pain in the extremities may be the first early warning of danger to cold stress. Numbness, tingling, itching, or a burning sensation may be other signs (Raynaud's phenomenon or Trench foot).

Signs of maximum severe shivering develop when the body temperature levels drop below 35°C or 95°F. This uncontrolled shivering is a sign of dangerous low body core temperatures (hypothermia) and work should be terminated. Decreased mental coherence, slurred speech, memory lapses, drowsiness, exhaustion, slow or irregular heartbeat, weak pulse, and blood pressure changes are other signs of hypothermia. If individuals demonstrate evidence of hypothermia or other significant cold injuries (e.g., frostbite), co-workers must notify the Hanford Fire Department by calling 911 or 373-0911 by cellular telephone.

2. Cold Stress Factors

Both environmental and personal health factors contribute to cold injury. Environmental factors include: exposure to cold temperatures, high humidity, high winds, contact with wetness or metal, or inadequate clothing. Personal factors include: allergies, vascular disease, excessive smoking and drinking, some medications, age, and general health condition. Cold stress is best prevented by gradual adaptation to cold conditions, hydration, proper diet, and engineering, administrative, and personal protective controls.

Acclimatization

Only a small degree of acclimatization occurs upon cold exposure. Acclimatization requires repeated exposure to painful levels of cold to be effective and is not considered in this standard.

Hydration

Significant water loss from the lungs and skin occurs upon exposure to the dry quality of cold air. Increased fluid intake is essential to ensure proper hydration, which allows adequate blood flow to the extremities.

Diet

A well-balanced diet is important for individuals working in cold environments to ensure adequate stores of energy.